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Description:
Riveted joint

Patent holder:
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Inventor:
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Date of application: July 24, 2001

Munich, November 7, 2002



The President of the German Patent and Trademark Office

[signature]

Dr. Schade

(19) FEDERAL REPUBLIC
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(56) Publications taken into consideration to evaluate
patentability:

US Patent 42,45,921
US Patent 29,91,858

(54) Riveted joint

(57) The patent describes a riveted joint wherein especially an upper component that is made of a brittle material is joined with a lower component that is made of metal over at least one rivet, consisting of a rivet head and a rivet shank. It is essential that the rivet head (2) and the upper component (4) that is made of brittle material on top of which the rivet head (2) lies exhibit cup-shaped rivet contact areas (15 and 16 and/or 21 and 22) that match each other, whereby a type of round head joint occurs. This makes it possible for the rivet head to swivel within the matching countersink when there are dynamic loads on the joint and thus when there is subsequent tilting of the rivet head, whereby constant pressure is exerted.

[figure]

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Description

[0001] The invention relates to a rivet joint wherein especially an upper component that is made of brittle material is joined with a lower component that is made of metal over at least one rivet in accordance with the heading of Claim 1, as these are generally used to join plate-shaped parts, especially through riveting.

[0002] Usually rivets are used as rigid, plate-shaped components where these rivets are always implemented with even surfaces in the head contact. That means that, in rivets with a set head—e.g. with a semicircular or flat head shape—the even head contact surface of the rivet is perpendicular to the longitudinal rivet axis and lies directly on the even surface of the upper component in an assembled state. In the case of rivets with countersunk heads, these even head contacts of the rivet exhibit a conical shape and are enclosed in a conic shrink mark of the upper component. When these rivet joints are under dynamic loads in which the components that are joined with each other by riveting can at least be easily moved toward each other, the rivets perform a type of whirling motion where they exert increased pressure on the material located underneath, especially with the outer edge of their heads, whether it is a set head or countersunk head. In the case of brittle or porous materials, however, this pressure results in excess loads on the basic material that occurs at these points on the head contact, which can result in the destruction of the rivet joint.

[0003] The problem that the invention solves is to create a rivet joint of the type named above that perfectly takes on a higher dynamic load, even as a rivet joint with brittle or porous materials.

[0004] This problem is solved by a rivet joint of the type named above with the distinguishing characteristics of Claim 1. Advantageous embodiments of the invention are identified in the subclaims.

[0005] In fact, a rivet joint has already been described in US Patent 4,245,921 in which cup-shaped contact surfaces are also intended on a joint head and rivet hole. However, this cup shape is not intended on the actual rivet head in particular but instead on the rivet point to be formed while the rivet joint is being completed. In addition, it is considered very important in the known rivet joint that its rivet be implemented with expenditure of energy and that the rivet point especially be molded under special pressing action into the matching countersink point in the component so that a certain part of the rivet material is displaced radially and interferes with the material of the drill hole. Because of this, the material undergoes a change in the sense of hardening, both in the rivet and in the component under the matching pressing action. Thus, the attempt with this rivet joint is to achieve as secure a cup joint as possible over the rivet point while the rivet head in all embodiments is a normal set head with an even contact surface. Thus—on precisely the end where the cup shape is intended in accordance with the patent registration—absolutely nothing is done about the excess material load caused by the pressure of the outer edge of the aligned rivet head, but instead the attempt is to exert even more pressure on the component materials by means of the cup-shaped rivet point. The cup shape of the known rivet joint is thus not primarily intended on the actual rivet head shaped as a set head or countersunk head and does not serve as a type of ball and socket joint specifically to relieve the pressure between

the parts of the joint.

[0006] Accordingly, the rivet head contact of the rivet head and of upper component exhibits a ball or cup shape; i.e. the rear end face of the rivet head, upon which the rivet or rivet head lies on top of the upper component, is spherical or ball-shaped, whereas the surface of the upper workpiece upon which the rivet head lies exhibits a cup-shaped depression surrounding the rivet hole, which matches the diameter of the cup in size and placement with that of the contact surface of the rivet head.

[0007] The rivet possess a type of ball and socket joint bearing in which a pivoting motion is performed when tilting the rivet joint under a dynamic load of the rivet head, with an essentially constant load along the entire head contact. An excess load on one side of the basic material that occurs when tilting a rivet in a straight embodiment, especially within the outer zone of the rivet head contact, cannot occur using the ball shape in accordance with the invention because the rivet head has the option from this point onward of swiveling, corresponding to the momentum of the load, whereby an essentially constant surface load is maintained.

[0008] The swiveling and tilting of the rivet joint is optimized even more when the rivet point that is formed on the free end of the shank of the rivet as well as the contact surface located underneath the lower component both exhibit a cup-shaped contact surface so that, when riveting it closed, the rivet point is correspondingly shaped into the cup-shaped countersink. A constant load on both ends of the rivet is achieved by forming both heads of the rivet joint essentially identically.

[0009] The invention is described in more detail below using example embodiments of the state of the art and of the invention, referring to the drawings. The drawings show the following:

[0010] Figure 1 shows an axial cross-section through a rivet joint in accordance with the state of the art using a countersunk head rivet, introduced into the drill holes of the components to be joined, in an unriveted state;

[0011] Figure 2 shows a cross-section similar to that in Figure 1 but through a rivet joint in accordance with the invention using a countersunk head rivet;

[0012] Figure 3 shows a cross-section similar to that in Figure 1 but through a rivet joint in accordance with the state of the art, using a set head rivet;

[0013] Figure 4 shows a cross-section similar to that in Figure 2; and

[0014] Figure 5 shows a rivet joint as in Figure 4, using a rivet point molded on the rivet using a cup-shaped contact surface.

[0015] As Figure 1 shows, a conventional countersunk head rivet 1 possesses a rivet head 2, here a countersunk head, and a rivet shank 3. It is manufactured entirely of the same material and serves to join—as illustrated here as an example—at least two plate-shaped components 4 and 5 that are intended with a coaxial drill hole 6, the rivet hole, wherein the conical rivet head 2 is set in a matching conical countersink 7 of the rivet hole 6 of the upper component 4. The rivet 1 performs whirling and tilting motions that are illustrated by the inclination of the rivet axis 13 through dynamic loads, during which the components 4 and 5 that are held together by the rivet joint cause displacement motion indicated by example of arrows 11 and 12. In doing so, rivet 1 will exert increased pressure on the material of component 4 located underneath, especially with the outer edge of the contact surface 8 of its head 2,

which is indicated by pressure points 14. The excess load arising this way, especially in the case of a brittle, porous material, can result in its destruction and, as a result of this, in the destruction of the entire rivet joint.

[0016] Figure 2 shows a rivet joint in accordance with the invention with a countersunk head rivet 10 in a similar arrangement as in the known rivet 1 from Figure 1. It is recognizable that the countersunk head 2 of this rivet 10 exhibits a cup-shaped contact surface 15 that fits in a cup-shaped depression 16 of the rivet hole 6. The rivet head 2 is thus essentially a hemisphere that fits in a ball socket formed by the depression 16 and with it creates a type of ball and socket joint. One can recognize that, with the whirling and tilting motions of the rivet 10 under a dynamic load, the ball head 2 of the rivet 10 swivels so that the entire contact surface 15 constantly exerts relatively uniform pressure on the depression surface 16.

[0017] In the set head rivet 17 in accordance with the state of the art and illustrated in Figure 3, the rivet head 2 is shaped as a flat head with an even contact surface 18, wherein the contact surface 18 lies evenly on the surface 19 of the component 4. With the whirling/tilting motions of the rivet 17, increased pressure is exerted especially over the outer edge zone of the head contact surface 18, which is indicated by the pressure points 14 in the drawing. At these pressure points 14, excess material load also occurs thus causing destruction of material.

[0017] In the set head rivet 20 in accordance with the state of the art and illustrated in Figure 4, the rivet head 2 is formed as a flat head with an even contact surface 21, wherein the contact surface 4 lies evenly on the surface 22 of the component 35. Thus, the rivet head no longer lies evenly on the surface 19 of the component 4, but instead along with the cup-shaped countersink 22 forms a type of ball and socket joint, similar to the embodiment shown in Figure 2. As additionally illustrated with the dotted line, the rivet point 23 is formed here 40 with straight contact surfaces because the lower component is a metal part and sustains the corresponding pressure loads with relatively few or no problems.

[0019] Finally, Figure 5 shows an embodiment as in Figure 4 wherein, however, the rivet point 23 of the rivet 20, similar to its set head 2, is intended with a cup-shaped contact surface 21, wherein the lower component 5 simultaneously possesses a matching countersink 22. One must recognize that, when tilting the rivet joint on both rivet heads 2 and 23, the heads swivel in an essentially identical manner in the cup-shaped countersinks 22.

Key to Reference Numbers

- 1 Countersunk head rivet (state of the art)
- 2 Rivet head
- 3 Rivet shank
- 4 Brittle component
- 5 Metal component
- 6 Drill hole 1 rivet hole
- 7 Depression, conical
- 8 Head contact surface, conical
- 10 Countersunk head rivet (invention)
- 11 Arrow
- 12 Arrow
- 13 Rivet axis
- 14 Pressure points

- 15 Head contact surface, spherical
- 16 Countersink, spherical
- 17 Set head rivet (state of the art)
- 18 Contact surfaced, rivet head
- 19 Surface, component
- 20 Set head rivet (invention)
- 21 Contact surface, rivet head
- 22 Countersink
- 23 Rivet point

Patent Claims

1. Rivet joint wherein especially an upper component that is made of brittle material is joined with a lower component that is made of metal over at least one rivet shank, characterized in that the rivet head (2) and the lower component (4) that is made of brittle material, on top of which the rivet head (2) lies, exhibit cup-shaped rivet contact areas (15 and 16 and/or 21 and 22) that match each other.
2. Rivet joint as under Claim 1 characterized in that, with the embodiment of the rivet as a countersunk head rivet (10), the contact surfaces (15, 16) each increasingly form a hemisphere, forming a contact surface of the type of a ball and socket joint.
3. Rivet joint as under Claim 1 characterized in that, with the embodiment as a set head rivet (20), the contact surfaces (21, 22) each possess at least a flat cup shape with a maximum radius equal to half the diameter of the head.
4. Rivet joint as under Claims 1 and/or 3 characterized in that the rivet point (23) of the rivet (20) also exhibits a cup-shaped contact surface (21) in the same manner as its set head (2), whereas in the lower component (5) a matching cup-shaped countersink (22) is intended.

For these see 1 page(s) of drawings

DRAWINGS, PAGE 1

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Int. Cl.⁷: **F16B 19/06**
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[Figures 1 through 5]

PETRA, ZIEGER & COLLEAGUES

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[receipt stamp]
SMI Products and Services

November 18, 2002

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To the firm
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November 15, 2002

Our Reference: 337-03.P
German Patent 101 35 230.1-24
"Rivet Joint"
Applicant: HOLLER, Wilhelm F., 92318 Neumarkt, Germany

Dear Mr. Holler:

The patent described below has been granted. We remind you that anyone may file an opposition to the granted patent within three months after its publication. If we receive any oppositions here, we will inform you immediately.

Enclosed please find your Certificate for the granting of your patent as well as a copy of the printed patent specification regarding the intellectual property rights described in more detail below:

Patent holder: **HOLLER, Wilhelm F., 92318 Neumarkt, Germany**

Patent number: **101 35 230**

File code: **101 35 230.1-24**

Description: **"Rivet Joint"**

Term of patent: **20 years**

Start of term: **July 24, 2001**

Due date for annual fee: **July 31**

Publication of the patent: **November 7, 2002**

Opposition possible until: **February 7, 2003**

Sincerely,

[signature]

E. Petra
Patent Attorney

Enclosures:

- Patent certificate (original)
- Patent specification (copy)

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File Code: 101 35 230.1-24
Your Ref.: 337-03.P
Appl. No.: 10491635
Holler

[receipt stamp]
PETRA, ZIEGER & COLL.

Rec.: March 12, 2003

Deadline:

No opposition has been filed to the patent.

We ask that in the future you indicate all submissions and payments for
file code 101 35 230.1-09.

This notice was created mechanically and is not signed.

Testing Office for Class F16B

Please indicate the applicant/patent holder and file code on all submissions; when making payments, also specify the purpose.

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Markt Schwaben,
November 15, 2002

Our Reference: 337-03.P

German Patent 101 35 230.1-24

"Rivet Joint"

Dear Mr. Holler:

The German Patent and Trademark Office has sent us two copies of the enclosed notice of March 5, 2003, regarding the aforesaid matter.

Please understand the notice to say that, happily, no effective opposition to the patent has been filed. The patent thus has the force of law and will tentatively run for a term of twenty years, that is until

July 24, 2021,

as long as nothing else occurs through a nullity action that cannot currently be foreseen.

There is nothing further to be done in this matter other than maintaining the patent by paying the annual fees. The annual fees are always due on **July 31 of every year.**

Sincerely,

[signature]

E. Petra
Patent Attorney

Enclosure:

- Second copy of notice of March 5, 2003